

**This Report Contains Proprietary and
Confidential Information**

Expert Report

**GARY J. REAL BIRD, EUGENIA C.
REAL BIRD, and GOLDMAN REAL
BIRD, Plaintiffs,**

vs.

**KCPK TRUCKING, INC., ROBERT J.
CARPENTER, CHARLES COOPER, and
JOSEPH FALCETTI, Defendants**

Case No. 15-CV-106-J

**John B. Minor, CSA CCE CSE
Communications Expert**

19 February 2016

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Signals Analyst / Forensic Examiner: John B. Minor, Communications Expert

Analysis Requestor: Larry G. Grubbs, PLLC

Case: GARY J. REAL BIRD, EUGENIA C. REAL BIRD, and GOLDMAN REAL BIRD, Plaintiffs, vs. KCPK TRUCKING, INC., ROBERT J. CARPENTER, CHARLES COOPER, and JOSEPH FALCETTI, Defendants

Case No. 15-CV-106-J

Evidence Reviewed or Analyzed: Amended Complaint-FILED, Verizon Wireless billing records for subscriber number (267)644-8165, Crash Report - Real Bird, CHART-Driving Hours, KCPK 00718-750 LOGS Carpenter, KCPK 001569-1630 Verizon bills Carpenter, KCPK 001569-1630 Verizon bills Carpenter-OCR, Verizon bill Dec 28-29, Verizon-Bill-01-02-2015, Verizon-Bill-11-02-2014, Verizon-Bill-12-02-2014

Analysis Objective: Analysis of the Verizon Wireless billing records for subscriber number (267)644-8165 for the period from October 7, 2014 through December 31, 2014, to determine that movement of the subscriber handset through various geographical areas was occurring. Analysis of Verizon Wireless billing records for subscriber number (267)644-8165 for December 28-29, 2014, to determine the movement of the subscriber handset until an accident occurred at approximately 10:50AM on December 29, 2014.

Date: 19 February 2016

Introduction

Cellular carrier networks are among the most complex and sophisticated networks. These networks are required to integrate each succeeding generation of technology while maintaining compatibility with earlier generation technologies. Cellular carriers necessarily maintain multi-path communications networks that exhibit self-healing characteristics when cell site components fail, therefore, multiple factors help determine which cell site sector a cell phone is registered to when placing or receiving a call. .

Cellular carrier networks are among the most complex and sophisticated networks, are required to integrate each succeeding generation of technology while maintaining compatibility with earlier generation technologies and must maintain multi-path communications networks that exhibit self-healing characteristics when cell site components fail, therefore, many factors help determine which cell site sector a cell phone is registered to when utilizing the cellular carrier infrastructure for voice, text or data communications.

This opinion is based upon several patented scientific concepts related to cellular communications technologies including standards set out in standards organizations including 3GPP (3rd Generation Partnership Project), 3GPP2 (3rd Generation Partnership Project 2, ETSI (European Telecommunications Standards Institute), Internet Engineering Task Force (IETF), International Organization for Standards (ISO), and Institute of Electrical & Electronic Engineers (IEEE).

Summary

An analysis of the Verizon Wireless billing records for subscriber number (267)644-8165 revealed that the subscriber handset regularly travelled through various geographical areas during the period from 7 October 2014 through 31 December 2014.

On 28 December 2014 the subscriber handset began travel from Falls City, Washington, traversing the states of Washington, Idaho, and Montana then turning south toward Sheridan, Wyoming, where an accident occurred at approximately 10:50AM on 29 December 2014. The subscriber handset was in an active 40 minute voice call beginning at 10:11AM when the accident occurred.

Science and Methodology

Multiple technologies are utilized within cellular carrier networks including radio frequency isotropic propagation technologies, well-known Public Switched Telephone Network (PSTN) communications standards based technologies, patented communications flow technologies, and a variety of data recording and gathering technologies. This section will not attempt to reiterate the corpora addressing the cellular carrier technology layers utilized in what are commonly referred to as 1G, 2G, 3G and 4G cellular communications but rather will address the science and methodology more directly applicable to documenting the usage of a mobile phone handset by a subscriber.

Cellular Device Carrier Network Registration & Communications Fundamentals

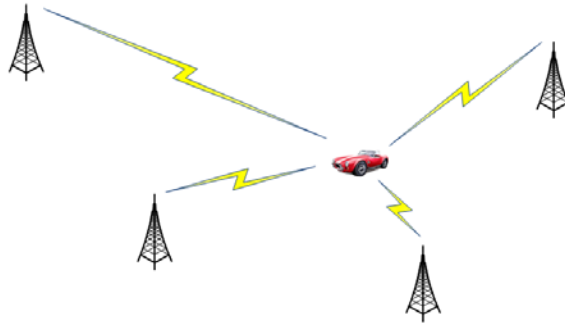
An understanding of how a cell phone call works, during both Mobile Originated (MO) or placed calls and Mobile Terminated (MT) or received calls, is essential to an understanding about how the billing call detail records analyzed in this case are related to specific access points or cell sites in a given region.

When a cell phone handset is switched on, and after performing an initial boot, a search is performed for cell sites in the vicinity. Cell sites may be as near as a few meters or as far away as 40 or more miles. The cell phone handset produces an internal list of available cell site sectors (identified as *cells*), normally alternating from 2 up to 6 cells depending on which cells are visible to the handset, called a Neighbor Set¹. The cell phone handset evaluates signal strength and other factors during communications with the network producing an orderly Active Set cell list from the Candidate Set cell list, receives an authorization from the network and registers with the most suitable cell site to place or receive a call. This interaction between cell phone handset and cell sites is accomplished using signaling channels² not visible to the cell phone handset user. The Neighbor Set is typically updated on average every 10-12 seconds from the moment the cell phone handset is booted.

¹ Neighbor Set is the Pilot superset of which Active Set and Candidate Set are subsets.

² Signaling channels consist of Pilot, Sync, & Paging channels.

Neighbor Set Example



When a call is placed or received and the cell phone handset is moving then a “handover” between cell sites or between adjacent antennae faces (sectors) of the same cell site may occur during the call.

Cellular Carrier Toll & Call Detail Records

The basis for cellular carrier CDR or call detail records is the toll or billing record. A CDR is produced by various telecommunications equipment components that document the details of subscriber usage communications sessions including voice, text or other data such as Internet usage passing through the cellular carrier core network. The records contain various attributes of each communications session such as date and time, duration, completion status, source and destination telephone numbers, and other details about each session.

The billing record contains much of the same information as CDR's with somewhat less detail regarding location. Billing records are the typical bill received by the subscriber from the cellular carrier.

Location Information

Billing records usually contain location information, often a city or other recognizable landmark, that relates to the SID or System IDentifier³ is the number that identifies a geographical portion of an operator's network for CDMA cellular carrier networks. In billing records the SID becomes an easily understandable location such as a city name.

Illustrated below are several examples of System IDentifiers:


00006 SEATTLE EVERETT Bellingham WA B Verizon Wireless
 00258 BELLINGHAM WA B Verizon Wireless
 00262 BILLINGS MT B Verizon Wireless

³ http://www.3gpp2.org/Public_html/specs/X%20R0070-0v1.0_20150625.pdf

01824 WYOMING 01 CODY B Verizon Wireless
 01826 WYOMING 02 SHERIDAN B Verizon Wireless
 01827 WYOMING 03 LINCOLN A Verizon Wireless
 01830 WYOMING 04 NIOBRARA B Verizon Wireless
 00284 CASPER WY B Verizon Wireless

BID or Billing IDentifier⁴ is the number, when used in conjunction with SID, used to identify an even smaller geographical area of the cellular carrier network, examples of which are small communities or landmarks ranging in radius from 5 to 25 miles depending upon the subscribers population density of each geographical area.

Below is an example portion of the Verizon Wireless bill for subscriber number (267)644-8165 with the origination location which correlates to the SID/BID circled in red.



verizon

wireless

Invoice Number

Account Number

Date Due

Page

7137995148

422764519-00001

01/28/15

15 of 21

Detail for Robert Carpenter: 267-644-8165

Voice, continued

Date	Time	Number	Rate	Usage Type	Origination	Destination	Min.	Airtime Charges	Long Dist/ Other Chgs	Total
12/28	8:27P	440-242-7855	Off-Peak	N&W	Missoula MT	Lorain OH	29	--	--	--
12/28	8:57P	440-242-7855	Off-Peak	N&W	Drummond MT	Lorain OH	25	--	--	--
12/28	9:22P	440-242-7855	Off-Peak	N&W	Gold Creek MT	Lorain OH	4	--	--	--

This numbering system is somewhat analogous to the Area Code in landline or POTS (plain old telephone service) communications.

The North American Numbering Plan is a closed numbering plan which prescribes ten digits for each complete destination routing code that is divided into three parts. The most significant part is a three-digit Numbering Plan Area (NPA) code (Area Code).⁵ The Area Code similarly relates to a geographical area within which landline subscribers are located.

Billing & Charging in 3G Cellular Carrier Networks

The standards bodies 3GPP and 3GPP2 provide billing and charging standards and guidance for CDMA based (Verizon) cellular carrier networks.

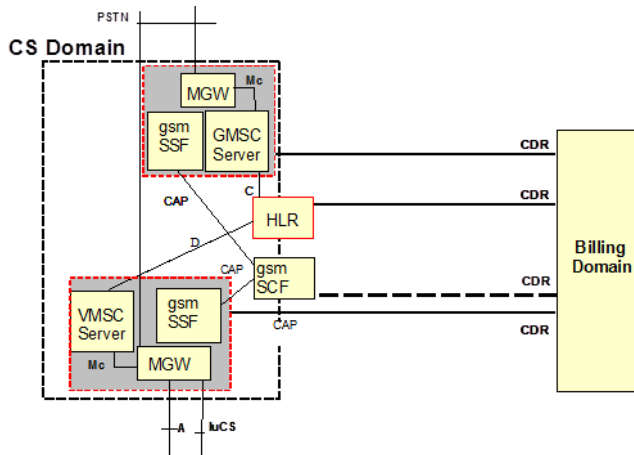
The Circuit Switched (CS) domain charging involves:

- the GMSC (Gateway Mobile Switching Center)

⁴ http://www.3gpp2.org/public_html/specs/X.S0004-000-E_v3.0_051102.pdf

⁵ https://en.wikipedia.org/wiki/Telephone_numbering_plan

- the MSC (Mobile Switching Center or server)
- the HLR (Home Location Register)
- the EIR (Equipment Identity Register)
- Offline Charging:
 - CDR types for MOC, MTC, IncGW, OutGW
- Online charging: CAMEL
- TS 03.78/09.78 (GSM)
- TS 23.078 / 29.078 (3GPP)



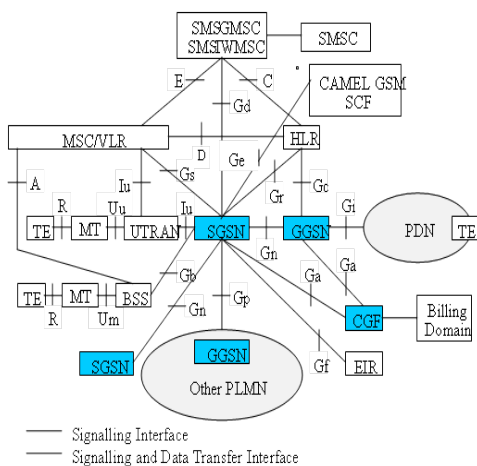
The Packet Switched (PS) domain (GPRS) charging involves the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN)

Offline Charging:

- M-CDR records MM items when user is GPRS attached
- S-CDR and G-CDR capture PDP context charging

Online charging:

- CAMEL based
 - TS 03.78/09.78 (GSM)
 - TS 23.078 / 29.078 (3GPP)
- Diameter based
 - Built upon IETF DCC



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Billing & Charging in 4G Cellular Carrier Networks

An important component in the LTE network is the policy and charging control (PCC) function that brings together and enhances capabilities from earlier 3GPP releases to deliver dynamic control of policy and charging on a per subscriber and per IP flow basis.

LTE Evolved Packet Core (EPC) EPC includes a PCC architecture that provides support for fine-grained QoS and enables application servers to dynamically control the QoS and charging requirements of the services they deliver. It also provides improved support for roaming. Dynamic control over QoS and charging will help operators monetize their LTE investment by providing customers with a variety of QoS and charging options when choosing a service.

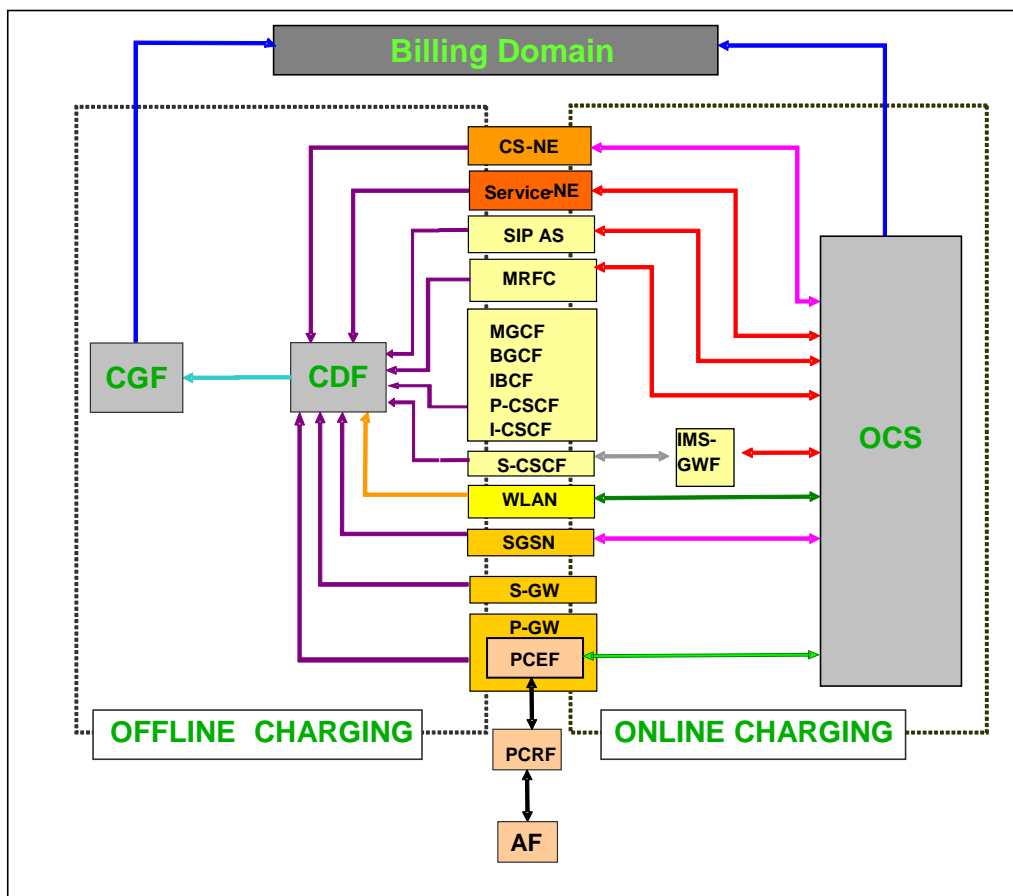
The LTE PCC functions include:

- PCRF (Policy and Charging Rules Function) provides policy control and flow based charging control decisions.
- PCEF (Policy and Charging Enforcement Function) implemented in the serving gateway, this enforces gating and QoS for individual IP flows on the behalf of the PCRF. It also provides usage measurement to support charging
- OCS (Online Charging System) provides credit management and grants credit to the PCEF based on time, traffic volume or chargeable events.
- OFCS (Off-line Charging System) receives events from the PCEF and generates charging data records (CDRs) for the billing system.⁷

GSM/UMTS/EPC networks provide functions that implement offline and/or online charging mechanisms on the bearer (e.g. EPC), subsystem (e.g. IMS) and service (e.g. MMS) levels. In order to support these charging mechanisms, the network performs real-time monitoring of resource usage on the above three levels in order to detect the relevant chargeable events.

⁶ <ftp.3gpp2.org/...047%203GPP%20SA5%20re%20Response%20to%203>

⁷ <http://ltefaq.org/ltefaq/how-does-policy-control-and-charging-works-lte>



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Overview of Methodology for Performing the Signals Analysis


The billing records provided by Verizon Wireless were analyzed for call frequency, duration and location during travels on 28 and 29 December 2014.

The analysis was conducted by reviewing the date, time, duration, and origination location of calls.

⁸ See 3GPP TS 32.240 V8.6.0

Verizon Billing Explanation

The Verizon Wireless billing entries are decoded in the graphic below:



Invoice Number

Account Number

Date Due

Page

7137995148

422764519-00001

01/28/15

15 of 21

Detail for Robert Carpenter: 267-644-8165

Voice, continued

Date	Time	Number	Rate	Usage Type	Origination	Destination	Min.	Airtime Charges	Long Dist/Other Chgs	Total
12/28	8:27P	440-242-7855	Off-Peak	N&W	Missoula MT	Lorain OH	29	--	--	--
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12/28	9:22P	440-242-7855	Off-Peak	N&W	Gold Creek MT	Lorain OH	4	--	--	--

The Date column is the date the call occurred.

The Time column is the time the call began, rounded to the nearest minute.

The Number column is the phone number of the party to which the call connected.

The Rate column is an explanation of the rate applied to the call.

The Usage Type column is the type of billing applied to the call, e.g., N&W = Nights and Weekends.

The Origination column is the subscriber handset general location during the call.

The Destination column is the general location of the party to which the call connected.

The Min. column is the duration of the call in minutes.

The Airtime Charges, Long Dist/Other Chgs, and Total columns are not in use in this billing.

Conclusions & Opinions

Based upon an analysis of billing records produced by Verizon Wireless for subscriber number (267)644-8165 (for 28 December 2014, through 29 December 2014, up to the time of an accident at approximately 10:50AM on 29 December 2014 and review of a variety of additional documents for the case styled REAL BIRD V KCPK TRUCKING, I, John B. Minor, reached the following opinions to a reasonable probability:

1. An analysis of the Verizon Wireless bill for subscriber number (267)644-8165 during the period from 7 October 2014 through 31 December 2014 revealed the movement of the subscriber handset during travels up to within an estimated 25 mile radius of the SID/BID for each call origination location entry, and,
2. An analysis of the Verizon Wireless bill for the period from December 3, 2014 through January 2, 2015 with a focus on December 28th and 29th, during which time the subscriber handset travelled from Fall City, Washington revealed travel through the states of Washington, Idaho, Montana and Wyoming over a 25 hour time period. The trip culminated in an accident at approximately 10:50AM on December 29, 2014, near Sheridan, Wyoming, and,

3. The analysis further revealed the travel path through the states of Washington, Idaho, Montana and Wyoming , and,
4. The analysis further revealed that the subscriber handset was moving during periods of time that driver logs indicated that the truck within which the handset was located during travels was stationary for hours at a time, and,
5. The subscriber handset began traveling from an area near Fall City, Washington, at approximately 8:49AM on 28 December 2014, passing through an area within an estimated 25 mile radius of Ellensburg, Washington, through 12:26PM that same date, and, (see Addendum 1, number 1 and 2)
6. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Warden, Washington, at approximately 1:52PM, and, (see Addendum 1, number 3)
7. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Kellogg, Idaho, at approximately 4:31PM, and, (see Addendum 2, number 4)
8. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Shoshone, Idaho, at approximately 4:54PM, and, (see Addendum 2, item 5)
9. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Saltese, Montana, between 6:45PM and 6:50PM, and, (see Addendum 2, item 6)
10. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Saint Regis, Montana, at approximately 7:02PM, and, (see Addendum 2, item 7)
11. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Missoula, Montana, between 8:15PM and 8:27PM, and, (see Addendum 2, item 8)
12. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Drummond, Montana, at approximately 8:57PM, and, (see Addendum 3, item 9)
13. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Gold Creek, Montana, between 9:22PM and 9:26PM, and, (see Addendum 3, item 10)
14. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Anaconda, Montana, between 10:03PM and 10:06PM, and, (see Addendum 3, item 11)
15. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Manhattan, Montana, between 11:20PM and 11:54PM, and, (see Addendum 3, item 12)
16. The subscriber handset continued travel within an area up to an estimated 25 mile radius of Three Fork, Montana, at approximately 11:56PM, and, (see Addendum 3, item 13)
17. On 29 December 2014 the subscriber handset continued travel within up to an area an estimated 25 mile radius of Columbus, Montana, at approximately 8:05AM, and, (see Addendum 4, item 14)
18. The subscriber handset continued travel within up to an area an estimated 25 mile radius of Joliet, Montana, between 8:06AM and 8:10AM, and, (see Addendum 4, item 15)
19. The subscriber handset continued travel within up to an area an estimated 25 mile radius of Toluca, Montana, between 9:15AM and 9:19AM, and, (see Addendum 4, item 16)
20. The subscriber handset continued travel within up to an area an estimated 25 mile radius of Hardin, Montana, between 9:25AM and 9:26AM, and, (see Addendum 4, item 17)
21. The subscriber handset continued travel within up to an area an estimated 25 mile radius of Wyola, Montana, at approximately 10:11AM, and, (see Addendum 4, item 18) further the subscriber handset was engaged in a 40 minute voice call until an accident occurred at approximately 10:50AM, and,

22. The subscriber handset registered with cell sites within up to an area an estimated 25 mile radius of Sheridan, Wyoming, beginning a call at 10:54AM, and, (see Addendum 4, item 19)
23. This same locational analysis would be applicable to all calls during the period from 7 October 2014 through 31 December 2014.

I reserve the right to alter any opinions based on additional documentation or other information produced after this report is submitted.

The following may be used as courtroom exhibits: amended Complaint-FILED, Verizon Wireless billing records for subscriber number (267)644-8165, Crash Report - Real Bird, CHART-Driving Hours, KCPK 00718-750 LOGS Carpenter, KCPK 001569-1630 Verizon bills Carpenter, KCPK 001569-1630 Verizon bills Carpenter-OCR, Verizon bill Dec 28-29, Verizon-Bill-01-02-2015, Verizon-Bill-11-02-2014, Verizon-Bill-12-02-2014, illustrations from this report and the maps included as addenda to this report.

Basis for Expert Opinion

I graduated Odessa Permian High School 1969. I attended Odessa Junior College between 1970 and 1973, undertaking studies in IBM Mainframe 360 Series programming (Assembly and Cobol languages), Systems Analysis, and other courses.

I received over 2,000 hours of technical vocational training, both online and traditional, in subject areas related to the cellular carrier network infrastructure including microwave, fiber optics and wired communications network protocols, network design and network equipment configuration, deployment and troubleshooting from Novell, Cisco, Siecor/Corning, IBM/Lucent, Microwave Networks, Hughes Satellite and other communications technology companies.

I received over 700 hours of training, both online and traditional, regarding cellular records and cellular radio/network design/communications related subjects from Qualcomm, iBwave, BK Forensics, Forensic Telecommunications Services, Paraben Corporation, ISSWorld/ TeleStrategies, Black Hat and The Mobile Forensics Annual Conference.

I have received training and certifications in cellular and GPS signals analysis and communications technologies design and deployment, including asynchronous transfer mode, fiber optics, and microwave communications networks design and deployment.

I received certification as a Certified Network Engineer, Novell Corporation in January 1991.

I received certification as a Certified Computer Examiner or CCE, certified and licensed by the International Society of Forensic Computer Examiners in May 2007. This certification requires 40 CEU's or continuing education hours for re-qualification on a bi-annual basis.

I received certification as a Certified Signals Analyst or CSA, trained and certified by Paraben Corporation in October 2007.

I received certification as a Certified Steganography Examiner, trained and certified by the Steganography Analysis and Research Center, SARC, in October 2007.

In 1981 I created Micro Research, a consultancy undertaking software development for the new IBM PC and marketing the software product "Personal Finance Tools". Micro Research began doing business as Computer Technology Associates (CTA) in 1987.

In 1990 I formed Minor, Tedford & Associates, Inc., a systems integration firm that designed and installed operational networks consisting of fiber optic, wireless and wired communications infrastructure for the industrial, manufacturing, banking, utility and medical industries.

In 1993, I developed, marketed and deployed an early generation wireless router product line called RadlinQ.

From 1996 to 2001, I owned and operated The Technology Education Center & Prometric Certification Testing Center, in El Paso, Texas, which conducted training, certification and testing of persons engaged in a variety of network communications and information technology fields.

From 2004 to 2011 I owned and operated AirlinQ, a wireless Internet Service Provider.

I hold a patent (Patent Number 9113307) for a process to validate cellular carrier records accuracy and cellular carrier records signals analysis and mapping accuracy.

Articles authored during the past 10 years include:

Digital Device Location Tracking - Cell Phones & Computers - Emails, Chats, Blog Posts...

A Litigators Guide to Preserving & Acquiring Cell Phone Carrier Evidence – Subpoena, Court Order or Search Warrant

A Litigators Guide to Cell Phone Location Evidence Part 1 – Understanding How a Cell Phone Call Works

A Litigators Guide to Cell Phone Location Evidence Part 2 – Understanding Live & Historical Cell Phone Location Tracking

A Litigators Guide to Cell Phone Location Evidence Part 3 – Centroids & Working Range

A Litigators Guide to Cell Phone Location Evidence Part 4 – Understanding Cell Phone E911 Call Geo-Location Techniques

A Litigators Guide to Simplified Cellular Carrier Cell Site Working Range Estimation Issues

A Litigators Guide to Cell Phone Location Evidence Part 5 – The Role of Cell Phone Evidence in Missing Persons/Homicide Cases

Cell Phone "Pinging" for Real-Time Location Tracking: Fact or Fiction

Cellular Handset Location Privacy - It May All Be About the Privacy Override Indicator

Cellular Carrier Handset Location & Call Detail Records Error Rates Overview

iPhone Evidence—Is IT That Good?

iPhone Evidence: The New Source - Includes Skype Evidence - February 2010 issue of Professional Investigator Magazine

Preserving & Acquiring Cell Phone Carrier Evidence Guide

Domain Name & Zone File Investigations

Carrier Evidence, Five Steps to Success - December 2009 - Intellenet Newsletter

Preserving & Acquiring Cell Phone Carrier Evidence - December 2009, Professional Investigator Magazine

The earliest cellular call detail records with location information that I have performed an analysis on were from 1999.

I have been qualified as an expert witness in numerous cases in federal and state courts in the United States.

I have reviewed over 200,000 pages of call detail records and other logging produced by cellular carriers over the past ten years, performed signals analysis and live and historical cell phone location mapping and testified in a variety of criminal and civil cases and participated in law enforcement missing person investigations.

I have been associated for many years with the cellular industry through sub-contracted projects. Most new installations and technology upgrades at cell sites are performed by sub-contractors. I have provided consulting and have had regular communications related to upgrades and maintenance performed by technical tower climbing crews, cellular network testing contracts, and backhaul provisioning for cell site to mobile switching center communications.

I am familiar with the network operations center and maintenance function, cellular carrier manager of radio frequency engineering responsibilities and the network implementation & testing procedures employed by cellular carriers.

My rate of compensation for my work in this case is generally \$450 per hour plus any direct expenses incurred. My compensation is based solely on the amount of time that I devote to activity related to this case and is in no way affected by any opinions that I render or the outcome of the litigation. I receive no other compensation for my work in this action. My compensation is not dependent on the outcome of this matter. See my complete fee schedule in Addendum 5.

Respectfully Submitted,

John B. Minor, CSA CCE CSE
Communications Expert

Addendum 1

Cell Phone Signals Analysis

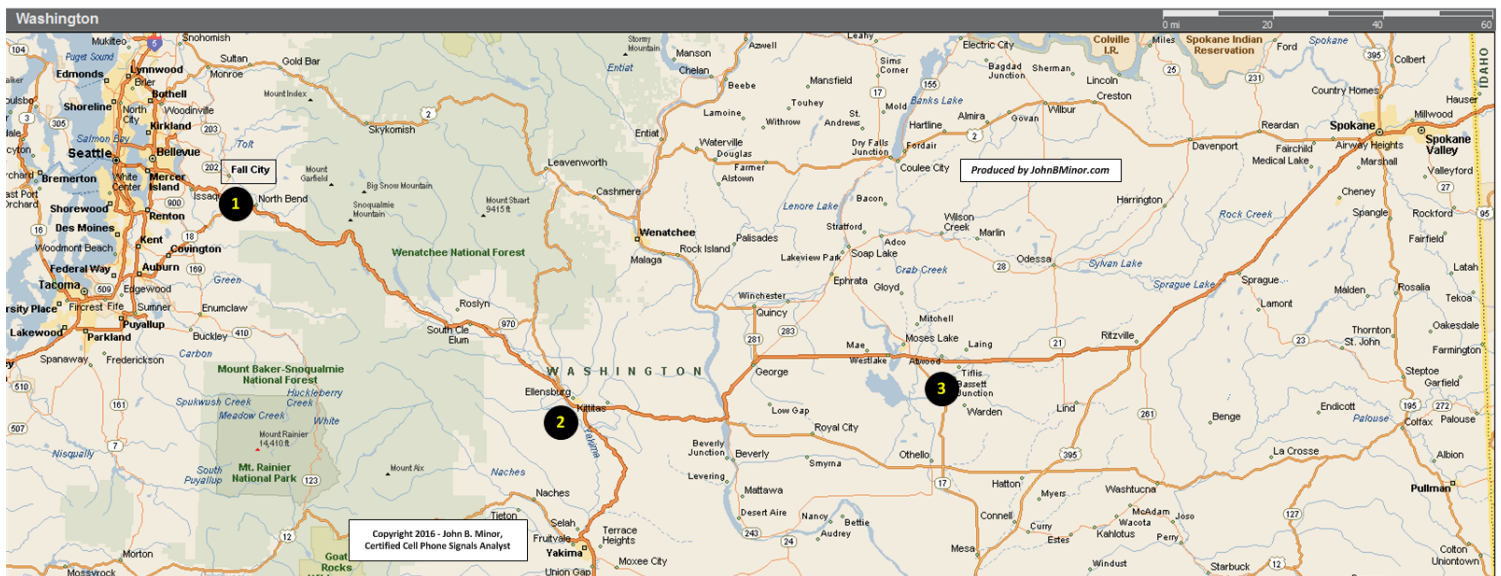
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Case No. 15-CV-106-J

Call Traffic Analysis Date: 28-29 December 2014

Target No.: (267)644-8165



Addendum 2

Cell Phone Signals Analysis

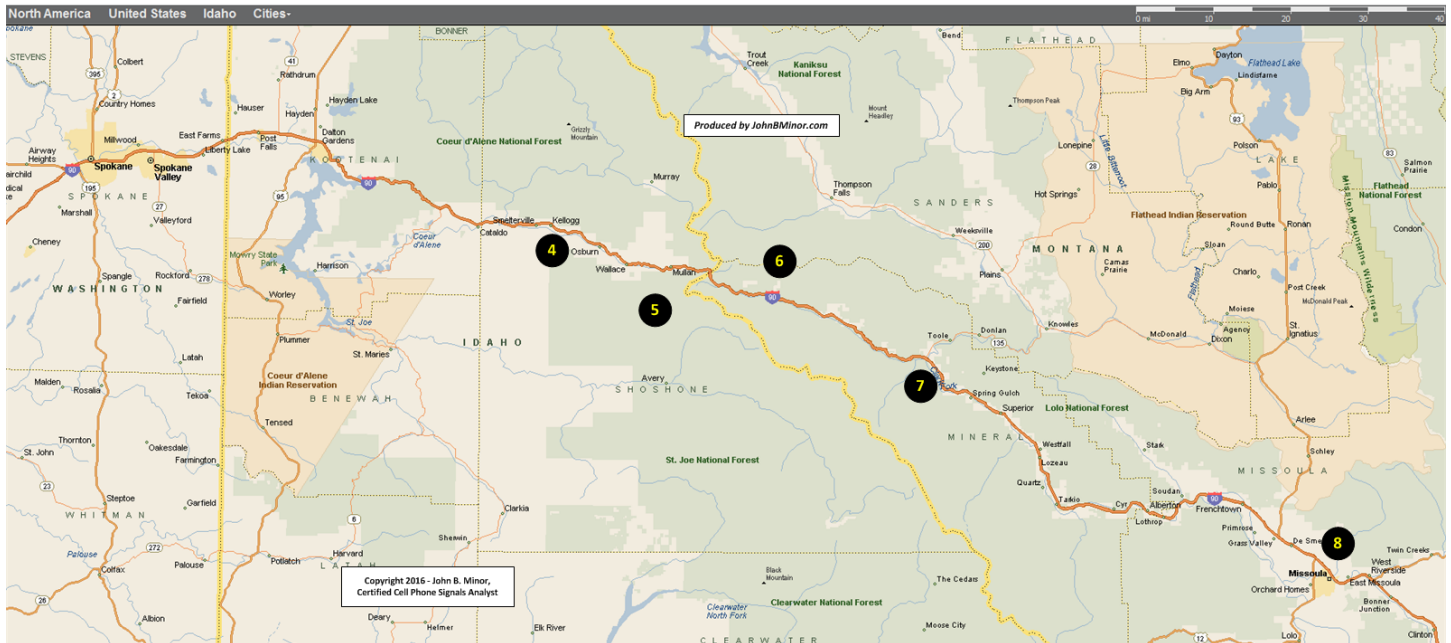
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Call Traffic Analysis Date: 28-29 December 2014

Target No.: (267)644-8165



Addendum 3

Cell Phone Signals Analysis

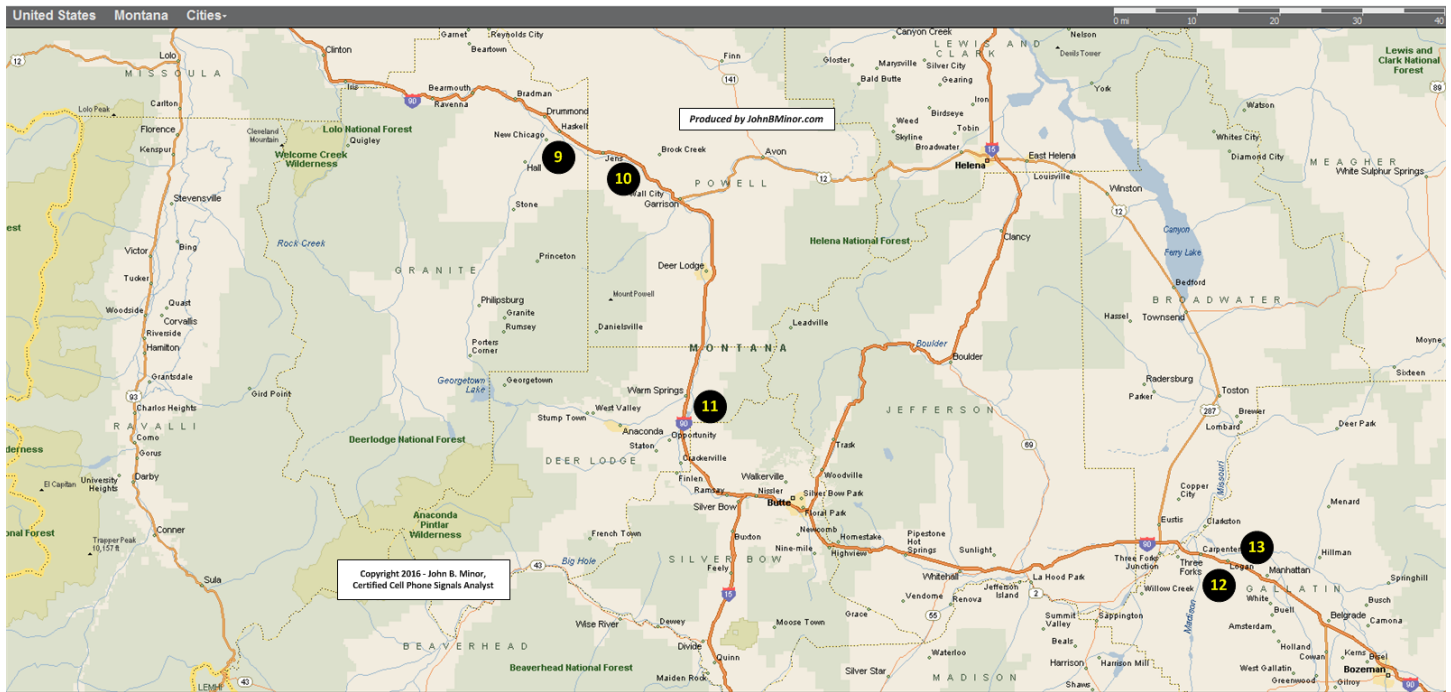
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Call Traffic Analysis Date: 28-29 December 2014

Target No.: (267)644-8165



Addendum 4

Cell Phone Signals Analysis

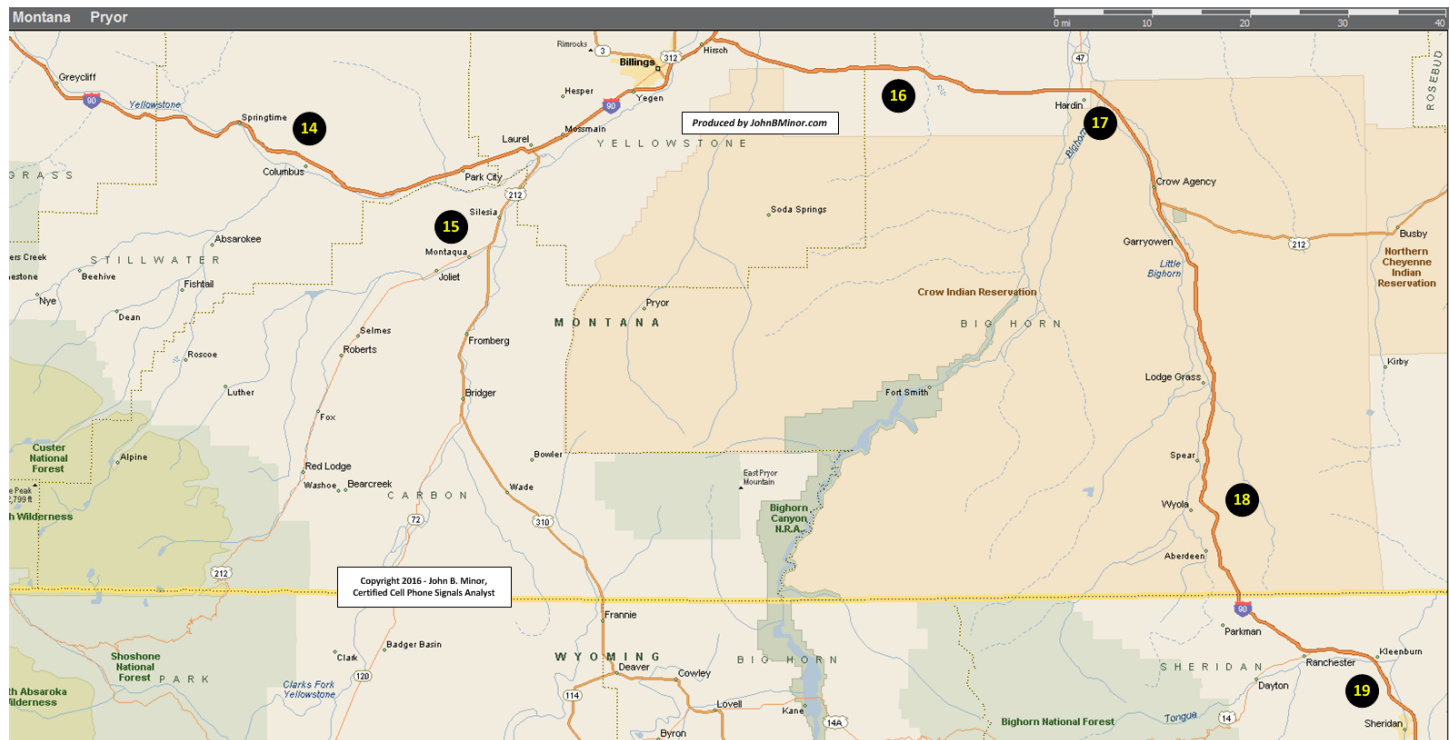
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Call Traffic Analysis Date: 28-29 December 2014

Target No.: (267)644-8165



Addendum 5

Certified by John B. Minor <jminor@johnbminor.net>, certificate issued by John B. Minor.

John B. Minor - Communications Expert

Litigation Support Expert Services Fee Schedule

EXPERT SERVICES

Expert Designation Fee -	\$1,000.00
Communications Expert WIFI/2G/3G/4G Overview Analysis Services -	\$550.00 per Hour
Cyber Intercept Analysis including Stored Communications Act or Wiretap Act Violations -	\$550.00 per Hour
Site/Network Security Vulnerability Analysis & Recommendations using Sandia Labs Risk Assessment Methodology -	\$500.00 per Hour

CELL PHONE/CELL PHONE CARRIER EVIDENCE TECHNICAL EXPERT SERVICES

Signals Analysis & Records Validation Methodology Patent Licensing	\$350.00 per Cell Site
Cell Phone Carrier Evidence Signals Analysis (Time Required Depends Upon Time Frame of Call Traffic Analysis/Volume of Records/ Additional Logging Obtained from Cell Phone Carrier) -	\$450.00 per Hour
Patent Litigation Technical Analysis, Infringing Methodology Claims Charting / Validation, Infringement Opinions, Accused Instrumentalities Language Development	\$550.00 per Hour
Cell Phone Carrier Cell Site Sector Radio Frequency Propagation Mapping Analysis/Tracking Cell Phone IMEI, ICCID, IMSI, etc. to Carrier, Country & Locale (when possible) of origin-	\$450.00 per Hour
Cell Phone Forensic Examination (Includes a Photo, Logical Memory or Physical Memory Examination of over 2,000 cell phone models) -	\$450.00 per Hour

FIBER OPTICS EXPERT SERVICES

Fiber Optics Consulting/Analysis (Link Loss Budget Calculation/Network Design/Specifications Development) -	From \$500.00 to \$850.00 per Hour
Fiber Optics Litigation Support/Condition Analysis (Time Required Depends Upon Fiber Strand Counts/# of Locations or Sites/Extent of Damage/Availability of Link Loss Budget, Damage Reports and Other Documents -	\$500.00 per Hour

Deposition or Courtroom Testimony - \$5,000.00 per Day

Advance Retainer ranges from \$5,000.00 to \$10,000.00 depending on estimated volume of work and is payable in advance of any work performed. All Travel & Per Diem is Payable in Advance of Travel to a Site.

Note - This is confidential information for recipient's eyes only. Do not forward.

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List of Cases Testimony Rendered in the Last Four Years

Federal Civil Case – Patent Infringement - PRISM TECHNOLOGIES LLC, Plaintiff, v. AT&T MOBILITY LLC, Defendant. CASE NO. 8:12-cv-122-LES-TDT. Retained by Plaintiff as Expert. Accepted and testified as Cellular Network, Network Security, Communications & Damages Expert in deposition and at trial.

Federal Civil Case – Patent Infringement - PRISM TECHNOLOGIES LLC, Plaintiff, v. SPRINT SPECTRUM L.P. d/b/a SPRINT PCS, Defendant. Civil Action No. 8:12-cv-123-LES-TDT. Retained by Plaintiff as Expert. Accepted and testified as Cellular Network, Network Security and Communications Expert in deposition and at trial.

Federal Civil Case – Patent Infringement - PRISM TECHNOLOGIES LLC, Plaintiff, v. T-Mobile, Defendant. Civil Action No. 8:12-cv-124-LES-TDT. Retained by Plaintiff as Expert. Accepted and testified as Cellular Network, Network Security and Communications Expert in deposition and at trial.

Alabama Civil Case – Wrongful Death Case – Caroline Page and Charles Page, Jr., as Personal Representative/Administrator of the Estate of Charles Page, Sr. v. Southern Cable Services, et al., Circuit Court of Limestone County, Alabama; CV 2011-900079. Retained by Plaintiff as Communications Expert. Accepted and testified as Communications Expert in deposition.

Texas Criminal Case - Capital Murder - State of Texas v. Mario Quintanilla, 139th Judicial District, Hidalgo County, Texas - Cause No. CR-1101-07-C. Contracted by the Hidalgo County District Attorney to assist the Capital Crimes Prosecution. Daubert hearing conducted. Accepted and testified as Communications Expert.

Texas Criminal Case - Double Capital Murder - State of Texas v. Brandon Dale Woodruff, 354th Judicial District, Hunt County, Texas - Cause No. 23,319. Judicial Appointment as Communications Expert on behalf of Defendant. Accepted and testified as Communications Expert.

Louisiana Criminal Case – Kidnapping – State of Louisiana v. Eddie Lee Jackson, Docket Number 293,902 (Parish of Caddo) – Retained by Caddo Parish District Attorney Charles Rex Scott as Communications Expert. Performed Signals Analysis, Drive Testing Analysis, Accepted & Testified as Communications Expert.

Louisiana Criminal Case – Murder – 2012-KK-0834 State of Louisiana v. Robyn Little Davis and Carol Nolan Saltzman (Parish of Calcasieu) – Retained by Defendants as Communications Expert. Accepted and testified as Communications Expert.

California Criminal Case – Gang Related Shooting – People of the State of California v. Juan Perez, Los Angeles Superior Court Case No. TA111316-01, Judicial appointment as Communications Expert on behalf of Defendant. Accepted and testified as Communications Expert.

California Criminal Case – 3 Count Capital Murder - People of the State of California v. Edwin Ramos Court No. 2373502, Judicial appointment as Communications Expert on behalf of Defendant. Accepted and testified as Communications Expert.

California Civil Case – Enslavement - Bim-Merle v. Perelman, Los Angeles Superior Court Case No. SC 117 101. Retained by Defendant. Defendant is a resident of Beverly Hills. Accepted and testified as Communications Expert.

Texas Intoxication Death Case - Texas Alcoholic Beverage Commission v. Marie's Drive Inn, L.L.C. SOAH DOCKET NO. 458-11-0253. Retained as Communications Expert. Accepted and testified as Communications Expert.

Texas Criminal Appeal Case – State of Texas v. James Hiatt. Contracted as Digital Forensics Expert by Attorney Cynthia Orr on behalf of Defendant. Accepted and testified as digital forensics/communications expert during appeal hearing on two separate occasions.

Federal Civil Case – Major Corporate Fraud – Propane Direct Enterprises, LLC, Plaintiff v. Brock Michael Hardy and Bruce Max Hardy, Defendants – Civil Action No. 7:09-CV-00100-RAJ –Contracted by Plaintiff as Communications Expert. Accepted and testified via declaration as Digital Forensics/Communications Expert.

Florida Criminal Case – Home Invasion Robbery – State of Florida v. Tyrone Law – Seminole County Case No. 09-3693-CFA – Retained by Defendant as Communications Expert. Accepted and testified as Communications Expert.

Florida Criminal Case – Lewd or Lascivious Battery Sex Act Under 16 Years of Age – State of Florida v. Tenzin P. Sangha & State of Florida v. Paul Smith. Case No. 2011-34202CFAES – Retained by judicial appointment on behalf of defendants. Accepted and testified on 3 occasions: Motion to Compel AT&T Hearing, Witness Deposition, and Daubert Hearing as Communications Expert.

Federal Civil Case - Stored Communications Act / Computer Intrusion Act Case - Strategic Wealth Group, LLC and Jerome Butkus, Plaintiffs v. Matthew Canno, Bret Binder, Philadelphia Settlement Brokers, LLC, and Binder & Canno, LLC, Defendants - United States District Court, Eastern District of Pennsylvania Civil Action No. 10-00321 – Contracted by Defendant as Communications Expert. Accepted and testified during deposition as Communications Expert.

Pennsylvania Civil Case – Wrongful Death Case - GARRETT K. PETTI, Administrator of the Estate of Patrick Petti, and MARCIA A. KARROW, Administratrix of the Estate of Barbara Warren, Plaintiffs, v. RIVERVIEW GOLF AND COUNTRY CLUB, INC. (d/b/a Riverview Country Club)(t/a The Sand Trap Pub) and JAMES BLACK, Defendants, No: C-0048-CV-2008-010956 - Retained by Defendant as Communications Expert. Accepted and testified as Communications Expert.

Wisconsin Criminal Case – Murder - State v. Robert Edwards, SPD File #: 10S-40-F-S03566 – Judicial appointment as Communications Expert. Accepted and testified as Communications Expert.

Connecticut Writ of Habeas Corpus Hearing – Murder Conviction – State of Connecticut v. Solomon Boyd – Docket No. CV 10-4003751 – Judicial Appointment as Communications Expert. Accepted and testified as Communications Expert.

Florida Civil Case – Injury Case – Odle v. Altria Client Services, Inc. & Studebaker – Case No. 10-38282(21) - Retained by Defendant as Communications Expert. Accepted and testified as Communications Expert in deposition.

Maryland Civil Case – Trade Secret Theft, Tortious Interference with Contract and Prospective Advantage, Fraud – Case No. 03-C-12-001648 - Maryland Orthotics & Prosthetics Company, Inc. v. Metro Prosthetics, Inc. and Dennis G. Haun and Peter H. Goller. Accepted and testified as Communications Expert.

Texas Criminal Case – Attempted Capital Murder – State of Texas v. John Howard, Cause No. F-2013-0489-D, 362nd Judicial District, Denton Co, Texas . Retained by Defendant. Accepted and testified as Communications Expert in pre-trial hearing.

Illinois Civil Case – Insurance Claim - Sam & Liza Costello v. State Farm Fire & Casualty Company, Court No.: 2013-L-7236. Retained by Plaintiff as Communications Expert. Accepted and testified as Communications Expert in deposition.

Abbreviations

3G	3 rd Generation
3GPP	3 rd Generation Partnership Project
AF	Application Function
AMF	Account Balance Management Function
AoC	Advice of Charge
APN	Access Point Name
AS	Application Server
BID	Billing IDentifier
BS	Bearer Services
BSC	Base Station Controller
BSS	Base Station Subsystem
BTS	Base Transceiver Station
CAMEL	Customized Applications for Mobile network Enhanced Logic
CAP	CAMEL Application Part
CDF	Charging Data Function
CDR	Charging Data Record
CG	Charging Gateway
CGF	Charging Gateway Function
CS	Circuit Switched
CSCF	Call Session Control Function (I-Interrogating; P-Proxy; and S-Serving)
CTF	Charging Trigger Function
EBCF	Event Based Charging Function
ECUR	Event Charging with Unit Reservation
EIR	Equipment Identity Register
EPS	Evolved Packet System
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
FQPC	Fully Qualified Partial CDR
GGSN	Gateway GPRS Support Node
GMLC	Gateway MLC
GMSC	Gateway MSC
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
gsmSCF	GSM Service Control Function
gsmSSF	GSM Service Switching Function
GSN	GPRS Support Node (either SGSN or GGSN)
HLR	Home Location Register
HPLMN	Home PLMN
HSCSD	High Speed Circuit Switched Data
IBCF	Interconnect Border Control Function
ICS	IMS Centralized Services
IEC	Immediate Event Charging
IETF	Internet Engineering Task Force
IMEI	International Mobile Equipment Identity
IMS GWF	IMS GateWay Function
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
ISC	IMS Service Control
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunication Union - Telecommunications standardization sector
LAC	Location Area Code
LAN	Local Area Network
LCS	Location Services
MAP	Mobile Application Part
ME	Mobile Equipment
MGW	Media GateWay
MLC	Mobile Location Center

MMI	Man-Machine Interface
MMS	Multimedia Messaging Service
MMSE	Multimedia Messaging Service Environment
MO	Mobile Originated
MOC	MO Call
MRF	Media Resource Function
MRFC	MRF Controller
MS	Mobile Station
MSC	Mobile Services Switching Centre
MSISDN	Mobile Station ISDN number
MT	Mobile Terminated
MTC	MT Call
NE	Network Element
OCF	Online Charging Function
OCS	Online Charging System
PCEF	Policy and Charging Enforcement Function
PCRF	Policy and Charging Rules Function
PDN	Packet Data Network
PDP	Packet Data Protocol, e.g. IP
PLMN	Public Land Mobile Network
PoC	Push-to-talk over Cellular
PS	Packet-Switched
PSPDN	Packet-Switched Public Data Network
QoS	Quality of Service
RF	Rating Function
RNC	Radio Network Controller
RNS	Radio Network Subsystem
RPC	Reduced Partial CDR
SBCF	Session Based Charging Function
SCCP	Signalling Connection Control Part
SCF	Service Control Function
SCUR	Session Charging with Unit Reservation
SGSN	Serving GPRS Support Node
SID	System IDentifier
SIM	Subscriber Identity Module
SMS	Short Message Service
SSF	Service Switching Function
TAP	Transferred Account Procedure
TR	Technical Report
TS	Technical Specification
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
USIM	Universal SIM
VAS	Value Added Service
VLR	Visitor Location Register
VMSC	Visited MSC
VPLMN	Visited PLMN
WLAN	Wireless LAN

Glossary

1G

First Generation wireless technology. Based on analog or AMPS technology, 1G wireless networks were designed to carry voice traffic only.

2G

Second Generation wireless technology. Based on digital technology, 2G wireless networks offer increased voice quality and capacity over 1G systems. 2G systems traditionally supported voice and circuit-switched data service. 2G systems are being replaced today by 2.5G and 3G networks.

3G

Third Generation wireless technology. Based on digital technology, 3G wireless networks offer increased voice capacity and provide higher data rates than 2G and 2.5G networks. As defined by the International Telecommunications Union (ITU), 3G technology has been or will be implemented as CDMA2000, CDMA2000 1xEV-DO, WCDMA/UMTS and HSDPA/HSUPA.

4G

The fourth generation of cellular wireless standards. It is a successor to the 3G and 2G families of standards. 4G is most often associated with LTE technology deployment.

A

Access Channel

A Reverse CDMA Channel used by mobile stations for communicating to the base station. The Access Channel is used for short signaling message exchanges, such as call originations, responses to pages, and registrations. The Access Channel is a slotted random access channel.

Active set

The set of pilots associated with the CDMA Channels containing Forward Traffic Channels assigned to a particular mobile station.

A-GPS

Assisted-Global Positioning System. A technology used to determine an end-user's position in urban areas or dense outdoor environments. Differs from traditional GPS by adding an assistance server, which shares tasks with the A-GPS receiver to expedite position location. Commonly associated with location-based services (LBS).

AMPS

Advanced Mobile Phone Service. The first analog cellular phone system commercially deployed in the 1980s.

Analog

In telecommunications, an early wireless network technology involving the modulation of radio signals, which transmit information as sound waves over radio signals allowing one call per channel. Most wireless transmission is now done digitally.

ANSI

The American National Standards Institute. A standards-setting, non-governmental organization that develops and publishes standards for transmission codes and protocols for use in the United States. ANSI serves as the official U.S. member body to the world's leading standards bodies, including the International Organization for Standardization (ISO).

B

Backhaul

Refers to transporting data or voice between the wireless network and the PDSN (packed data serving node, in wireless communications).

Band

In wireless communications, a frequency or contiguous range of frequencies.

Bandwidth

In wireless communications, the width or capacity of a communications channel. Analog bandwidth is measured in hertz (Hz). Digital bandwidth is the volume of data that a channel can carry and is measured in bits per second (bps).

Base Station

Often called a cell tower or a cell site, a base station is a transmitter/receiver location that establishes radio links between the wireless system and the wireless device. The base station includes an antenna tower, transmission radios and radio controllers. Each geographic area in a cellular network requires a base station.

Base Station Controller. A component of a base station, the BSC supervises the functioning and control of multiple base transceiver stations and acts as a small switch.

BTS

Base Transceiver Station (Cell Site). Includes the electronic equipment and the antenna that comprises a PCS (personal communications services) facility or single base station.

C

Candidate set

The set of pilots that have been received by the mobile station with sufficient strength to be successfully demodulated, but have not been placed in the Active Set by the Base station. See also Active Set, Neighbor Set, and Remaining Set.

Carrier

In wireless communications, an electromagnetic pulse or radio wave transmitted at a steady base frequency. Used to transmit radio signals to a radio receiver. Also commonly used to refer to a wireless network operator or service provider that provides mobile telecommunications services.

CDMA

Code Division Multiple Access. A digital wireless technology that works by converting analog information, such as speech, into digital information, which is then transmitted as a radio signal over a wireless network. CDMA uses spread-spectrum technology, decreasing potential interference while achieving privacy. CDMA technology is the basis for third-generation (3G) wireless technologies which offer increased voice capacity and provide higher data rates than 2G and 2.5G networks.

CDMA2000

CDMA2000 (also known as IMT Multi-Carrier (IMT-MC)) is a family of 3G mobile technology standards, which use CDMA channel access, to send voice, data, and signaling data between mobile phones and cell sites.

Cell

The geographic area encompassing the signal range from one base station. Wireless networks are comprised of many overlapping cells to efficiently use radio spectrum for wireless transmissions.

Cell Breathing

In CDMA-based mobile telephone systems, the effect of radio interference from other mobile transmitters in the same cell or coverage area is very marked and has a special name, cell breathing.

Cell Site

A fixed transmitter/receiver location, also known as a base station or a cell tower, which establishes communications between a wireless system and a wireless device using radio links. The cell site

includes an antenna tower, transmission radios and radio controllers.

Cell Tower

A fixed transmitter/receiver location, also known as a base station or a cell site, which establishes communications between a wireless system and a wireless device using radio links. The cell tower includes an antenna tower, transmission radios and radio controllers.

Cellular

Analog or digital communications that provide a consumer with a wireless connection from the mobile device to a relatively nearby transmitter (base station). The transmitter's coverage area is called a cell.

Centroid

Mathematical center of the coverage area of a cell.

Channel

The amount of wireless spectrum occupied by a specific technology implementation. For cellular communications, there is a transmit side and a receive side. For example, a 5 MHz channel uses 5 MHz to transmit and 5 MHz to receive, using a total of 10 MHz of wireless spectrum.

Coverage Area

Geographic area served by a cellular system in which service is available to wireless users.

D

dBm

dBm (sometimes dBmW) is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW). It is used in radio, microwave and fiber optic networks as a convenient measure of absolute power because of its capability to express both very large and very small values in a short form. Compare dBW, which is referenced to one watt (1000 mW).

Digital

A form of transmission that transforms analog signals, such as voice, into a series of electrical or optical pulses that represent the binary digits 0 and 1. This numerical data is then converted into various forms depending on the type of network, such as radio waves for wireless transmission, electronic pulses for a wired network or optical light waves for fiber optics. Digital networks offer superior Quality of Service (QoS), secure transmission and more bandwidth than analog lines.

Dual Band

Functionality that allows a mobile phone to transmit in two frequencies for wider coverage area. For

example, a mobile phone may be equipped to use both the 800 MHz cellular and 1900 MHz PCS frequencies to send and receive calls.

Dual Mode

Functionality that allows a mobile phone to operate in two different modes for greater roaming capabilities. For example, a mobile phone may be equipped to support both CDMA2000 and WCDMA standards to send and receive calls.

E

E911

Enhanced 911. A U.S. Government-mandated capability that automatically provides the caller's geographic location and wireless phone number to the 911 call center. The goal of the FCC's wireless E911 rules is to improve the effectiveness of wireless 911 service by providing emergency dispatchers with location information to within 50 to 300 meters of the caller's exact location.

EV-DO

Third-generation wireless technology that offers broadband data speeds to support applications such as VPN access, video downloads and large file transfers.

F

FCC

Federal Communications Commission. The U.S. government agency responsible for regulation of the communications industry.

Forward CDMA Channel

A CDMA Channel from a base station to mobile stations. The Forward CDMA Channel contains one or more code channels that are transmitted on a CDMA frequency assignment using a particular pilot PN offset.

Frequency

The rate at which an electromagnetic waveform alternates. Usually measured in hertz (Hz) or megahertz (MHz).

G

GB

Gigabyte. A measure of computer data storage capacity. Measured as approximately a billion bytes or 1,073,741,824 in decimal notation.

GHz

Gigahertz. A measure of frequency equal to a billion hertz or a thousand megahertz (MHz). Gigahertz is often used to measure UHF (ultra-high frequency) or to express microprocessor clock speed in some computers.

GPS

Global Positioning System. A worldwide radio-navigation system developed by the U.S. Department of Defense to enable users to determine their exact location anywhere on the globe from land, air or sea. GPS works via radio signals sent from orbiting satellites to receivers on the ground. GPS receivers are used in a wide range of commercial applications from fleet management to rural navigation.

gpsOne®

An assisted-GPS (A-GPS) position-location technology developed by Qualcomm. Integrates data from both wireless network base stations and GPS satellites for a highly-accurate location description. Enables location-based services for wireless devices that work in all types of terrains and dense metropolitan areas.

GSM

Global System for Mobile Communications. A second-generation wireless telecommunications standard for digital cellular services first deployed in Europe. GSM is based on TDMA technology and provides circuit-switched data connections.

H

Handoff

The process, invisible to the user, of transferring a cellular phone conversation from one base station (cell tower) to another without interruption to the call. There are two types of handoffs: hard and soft.

Handset

A wireless device that contains a transmitter and receiver. Also known as a cellphone or mobile phone.

Hyperbolic Positioning

The process of locating an object by accurately computing the time difference of arrival (TDOA) of a signal emitted from that object to three or more receivers. It also refers to the case of locating a receiver by measuring the TDOA of a signal transmitted from three or more synchronized transmitters.

I

Intellectual Property - a.k.a. IP

Intellectual Property. Refers to property rights created through intellectual and/or discovery efforts of a creator that can generally be protected under patent, trademark, copyright, trade secret, trade dress or other law.

IS-95

Interim Standard 95. The interim standard for CDMA-based cellular networks.

L

LAC

A Location Area Code is used for paging in order to indicate in which Location Area a cell phone handset is currently situated.

LBS

(Location Based Services) A location-based service (LBS) is an information or entertainment service, accessible with mobile devices through the mobile network and utilizing the ability to make use of the geographical position of the mobile device.

LTE

Long Term Evolution. A highly optimized mobile broadband OFDMA solution designed from the ground up to deliver high-speed broadband data, voice (VoIP), and Multimedia services. LTE complements existing 3G solutions by leveraging wider bandwidths (up to 20MHz), and advanced antenna techniques (MIMO, SDMA and Beam forming). LTE and UMB have similar features and are expected to have similar performance.

LTE Advanced

A preliminary mobile communication standard, formally submitted as a candidate 4G system to ITU-T in late 2009, was approved into ITU, International Telecommunications Union, IMT-Advanced and expected to be finalized by 3GPP in early 2011. It is standardized by the 3rd Generation Partnership Project (3GPP) as a major enhancement of the 3GPP Long Term Evolution (LTE) standard.

M

Mbps

Megabits per second. Measured as one million bits per second. A measurement of the amount of data transferred in one second between two telecommunication points.

MHz

Megahertz. One million hertz or cycles per second. A measurement often used to describe the speed

of digital and analog signals.

MIMO

Multiple Input, Multiple Output. In wireless communications, an antenna technology that uses multiple antennas at the source (transmitter) and the destination (receiver). Antennas at each end are combined to reduce errors and improve data speed.

MMS

Multimedia Messaging Service. Allows wireless device users to send multimedia, such as video or digital photos, from one device to another.

Morphologies

Morphologies consist of medium that reflect, refract or absorb radio frequency propagation.

Multilateration

The process of locating an object by accurately computing the time difference of arrival (TDOA) of a signal emitted from that object to three or more receivers. It also refers to the case of locating a receiver by measuring the TDOA of a signal transmitted from three or more synchronized transmitters.

Multipath Fading

Interference during wireless signal reception caused by the deflection of a radio signal off obstacles such as buildings, mountains and other large obstructions.

N

Neighbor Set

The set of pilots associated with the CDMA Channels that are probable candidates for handoff. Normally the Neighbor Set consists of the pilots associated with CDMA Channels that cover geographical areas near the mobile station.

P

PA - Power Amplifier

The term "power amplifier" is a relative term with respect to the amount of power delivered to the load and/or sourced by the supply circuit. In general a power amplifier is designated as the last amplifier in a transmission chain (the *output stage*) and is the amplifier stage that typically requires most attention to power efficiency. Efficiency considerations lead to various classes of power amplifier

Packet

A digital "package" of data that enables efficient use of radio spectrum and routing over a network,

such as the Internet or wireless networks. Each packet is numbered separately and includes the Internet address of the destination.

Pilot Channel

An un-modulated, direct-sequence spread spectrum signal transmitted by a CDMA base station or mobile station. A pilot channel provides a phase reference for coherent demodulation and may provide a means for signal strength comparisons between base stations for determining when to handoff.

Pilot Set

See Active Set, Candidate Set, and Neighbor Set.

PCS

Personal Communications Services. Refers to the 1900 MHz cellular frequency band. More commonly used as a marketing term to describe digital wireless services in the Americas, regardless of the particular frequency band being used.

POTS

Plain Old Telephone Service. The basic wired telephone line that supports standard single-line telephones, telephone lines and access to the PSTN (public switched telephone network).

Protocol

Within the context of data communications, a specific set of rules related to data transmission between two devices. Protocols set standard procedures that enable different types of data devices to recognize and communicate with each other.

PSTN

Public Switched Telephone Network. Refers to the local, long-distance and international phone system. In the United States, PSTN refers to the entire collection of interconnected phone companies.

QoS

Quality of Service. A measure of network's transmission reliability and efficiency. QoS is commonly used by network operators to indicate a higher level of service guarantee to customers.

R

Rake Finger Receiver

A radio receiver designed to counter the effects of multipath fading; commonly used in devices such

as mobile phones. Uses several sub-receivers or fingers, each slightly delayed, to tune into the individual paths a radio wave follows (multipaths). Each component is later combined to effectively strengthen the signal.

Reverse CDMA Channel

The CDMA Channel from the mobile station to the base station. From the base station's perspective, the Reverse CDMA Channel is the sum of all mobile station transmissions on a CDMA frequency assignment.

RSCP (Received Signal Code Power)

In the UMTS cellular communication system, RSCP denotes the power measured by a receiver on a particular physical communication channel. It is used as an indication of signal strength, as a handover criterion, in downlink power control, and to calculate path loss. In CDMA systems, a physical channel corresponds to a particular spreading code, hence the name.

RF

Radio Frequency. Measured in Hertz, MHz and GHz. Wireless and cordless telephones, radio and television broadcast stations, satellite communications systems and two-way radio services all operate using radio frequencies.

Roaming

Refers to a cellular subscriber using mobile phone service while outside of his/her service provider's coverage area.

RSCP (Received Signal Code Power) In the UMTS cellular communication system, received signal code power (RSCP) denotes the power measured by a receiver on a particular physical communication channel. It is used as an indication of signal strength, as a handover criterion, in downlink power control, and to calculate path loss. In CDMA systems, a physical channel corresponds to a particular spreading code, hence the name.

S

Signaling Channels

Cellular carrier communications channels used to monitor and control user channels such as voice, SMS and data channels.

Smartphone

A category of mobile phones that supports both wireless data and voice capabilities. Smartphones include enhanced software and applications, including operating systems such as Palm OS and Windows Mobile. In addition to telephone functionality, features on a smartphone might include email, Internet access and remote access to corporate databases.

SMS

Short Messaging Service. A store-and-forward message service available on many second-generation and all third-generation wireless networks that allows users to send and receive short text messages over wireless devices.

Soft Handoff

The process, invisible to the user, of transferring a cellular phone conversation from one base station (cell tower) to another without interruption to the call. There are two types of handoffs: hard and soft. Soft handoffs do not require the original connection to be broken when transferring to an adjacent base station.

Spread Spectrum

A method of transmitting a radio frequency (RF) signal by “spreading” it over a broad range of frequencies. This facilitates reduced interference and increased capacity within a particular radio frequency band. CDMA technology is based on spread spectrum.

Subscriber

In wireless, a user of a mobile telecommunication service.

Sync Channel

A code channel in the Forward CDMA Channel which transports the synchronization message to the mobile station.

T

Traffic Channel, and the Reverse Pilot Channel

See also Power Control Bit. Power Controlled Access Mode. A mode used on the Enhanced Access Channel where a mobile station transmits an Enhanced Access preamble, an Enhanced Access header, and Enhanced Access data in the Enhanced Access probe using closed loop power control.

Trilateration

The process of determining absolute or relative locations of points by measurement of distances, using the geometry of spheres or triangles. It is mainly used in surveying and navigation, including global positioning systems (GPS). In contrast to triangulation it does not involve the measurement of angles. Trilateration uses distances or absolute measurements of time-of-flight from three or more sites

U

UMTS

Universal Mobile Telecommunications System. A third-generation (3G), CDMA-based wireless communication standard that offers enhanced voice and data capacity and higher data rates than previous, second generation wireless technologies.

W

WCDMA

Wideband CDMA. A third-generation (3G), CDMA-based wireless communication technology that offers enhanced voice and data capacity and higher data rates than previous, second-generation wireless technologies.